Eurasian Soil Science 2016 vol.49 N12, pages 1375-1381

Contact angles at the water–air interface of hydrocarbon-contaminated soils and clay minerals

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Abstract

© 2016, Pleiades Publishing, Ltd.Contact angles at the water–air interface have been measured for triturated preparations of clays and soils in order to assess changes in their hydrophobic properties under the effect of oil hydrocarbons. Tasks have been to determine the dynamics of contact angle under soil wetting conditions and to reveal the effect of chemical removal of organic matter from soils on the hydrophilicity of preparations. The potentialities of static and dynamic drop tests for assessing the hydrophilic–hydrophobic properties of soils have been estimated. Clays (kaolinite, gumbrine, and argillite) have been investigated, as well as plow horizons of soils from the Republic of Tatarstan: heavy loamy leached chernozem, medium loamy dark gray forest soil, and light loamy soddy-calcareous soil. The soils have been contaminated with raw oil and kerosene at rates of 0.1–3 wt %. In the uncontaminated and contaminated chernozem, capillary water capacity has been maintained for 250 days. The contact angles have been found to depend on the degree of dispersion of powdered preparation, the main type of clay minerals in the soil, the presence and amount of oxidation-resistant soil organic matter, and the soil–water contact time. Characteristic parameters of mathematical models for drop behavior on triturated preparations have been calculated. Contamination with hydrocarbons has resulted in a reliable increase in the contact angles of soil preparations. The hydrophobization of soil surface in chernozem is more active than in soils poorer in organic matter. The complete restoration of the hydrophilic properties of soils after hydrocarbon contamination is due to the oxidation of easily oxidizable organic matter at the low content of humus, or to wetting during several months in the absence of the mazut fraction.

http://dx.doi.org/10.1134/S1064229316120115

Keywords

dark gray forest soil (Luvic Greyzemic Phaeozem), humus, hydrocarbon contamination, leached chernozem (Luvic Chernozem (Pachic)), soddy-calcareous soil (Eutric Rendzic Leptosol), soil hydrophilicity, wettability